Evaluation of AIRS RTA Errors versus Viewing Angle

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Overview

- Absolute, and relative, RTA errors still remain
- Possibly very important for CO_2 retrievals
- Introduce subtle biases into L2 products
- Present approach to mitigate RTA errors: L2 algorithm adds a fixed B(T) to the observed radiances
- New laboratory spectroscopy will probably not help at this level
- In-situ measurements probably not helpful either (maybe for H_2O?)
- Model error should be independent of viewing angle
- Use bias errors versus ECMWF as a function of secant angle to correct RTA. Done by assimiation systems.

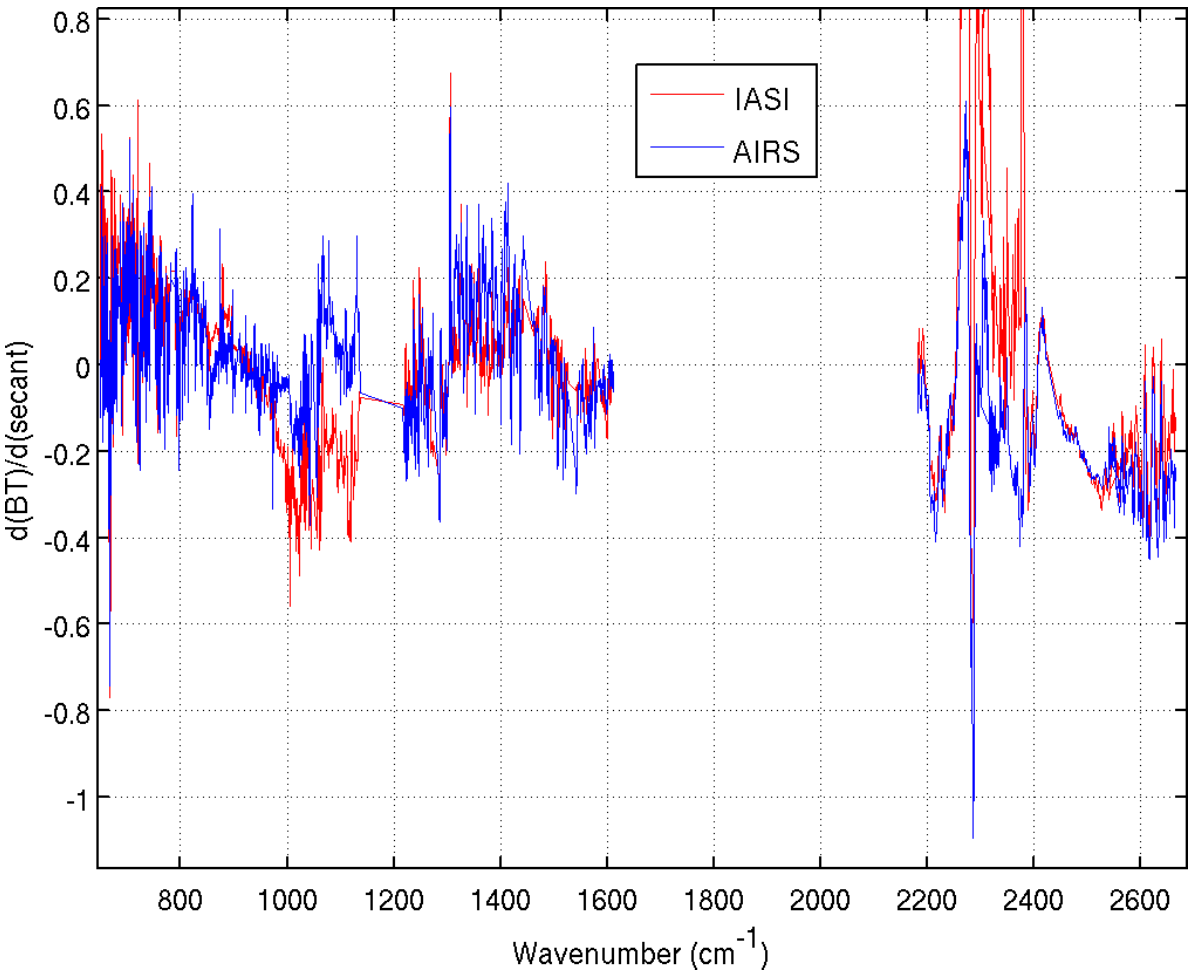
Biases vs ECMWF Vary with Secant of Viewing Angle

- Spectroscopy errors will vary with viewing angle/secant since you are changing pathlength
- Assume ECMWF errors do not depend on secant angle
- Fit $bias = offset + slope \times secant$
- Still need atmospheric constituent amount/profile to get spectroscopy, but second order error.

Fit Results: Slope of d(bias)/d(sec)

Secant varies from 1 to 1.37

IASI and AIRS biases produce almost same slope, implies spectroscopy and/or RTA paramterization errors.



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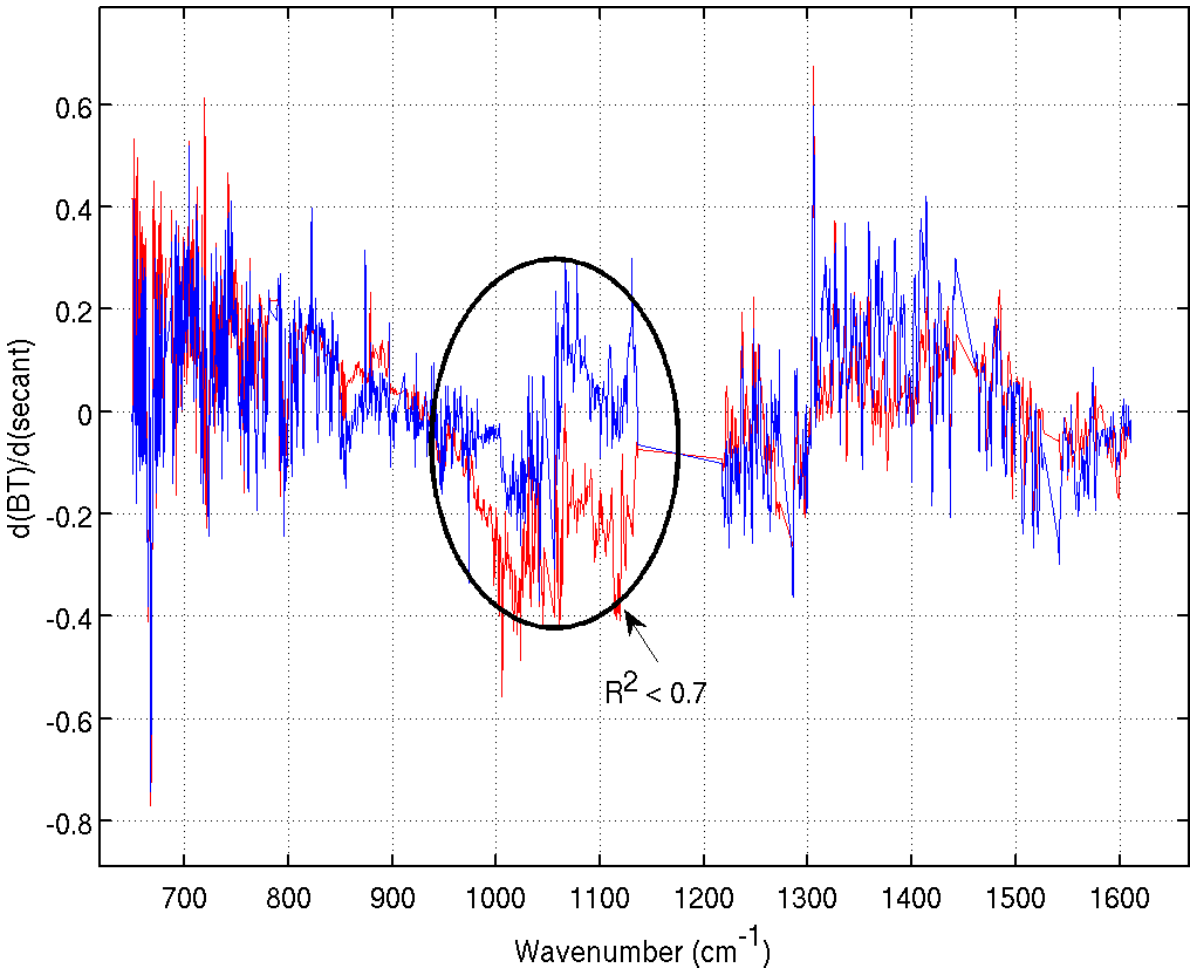
IASI and AIRS Disagree Near O_3 Region

The fit R^2 statistic is low where they disagree, implying a linear slope cannot explain variation with secant. This is also a region of almost zero slope.



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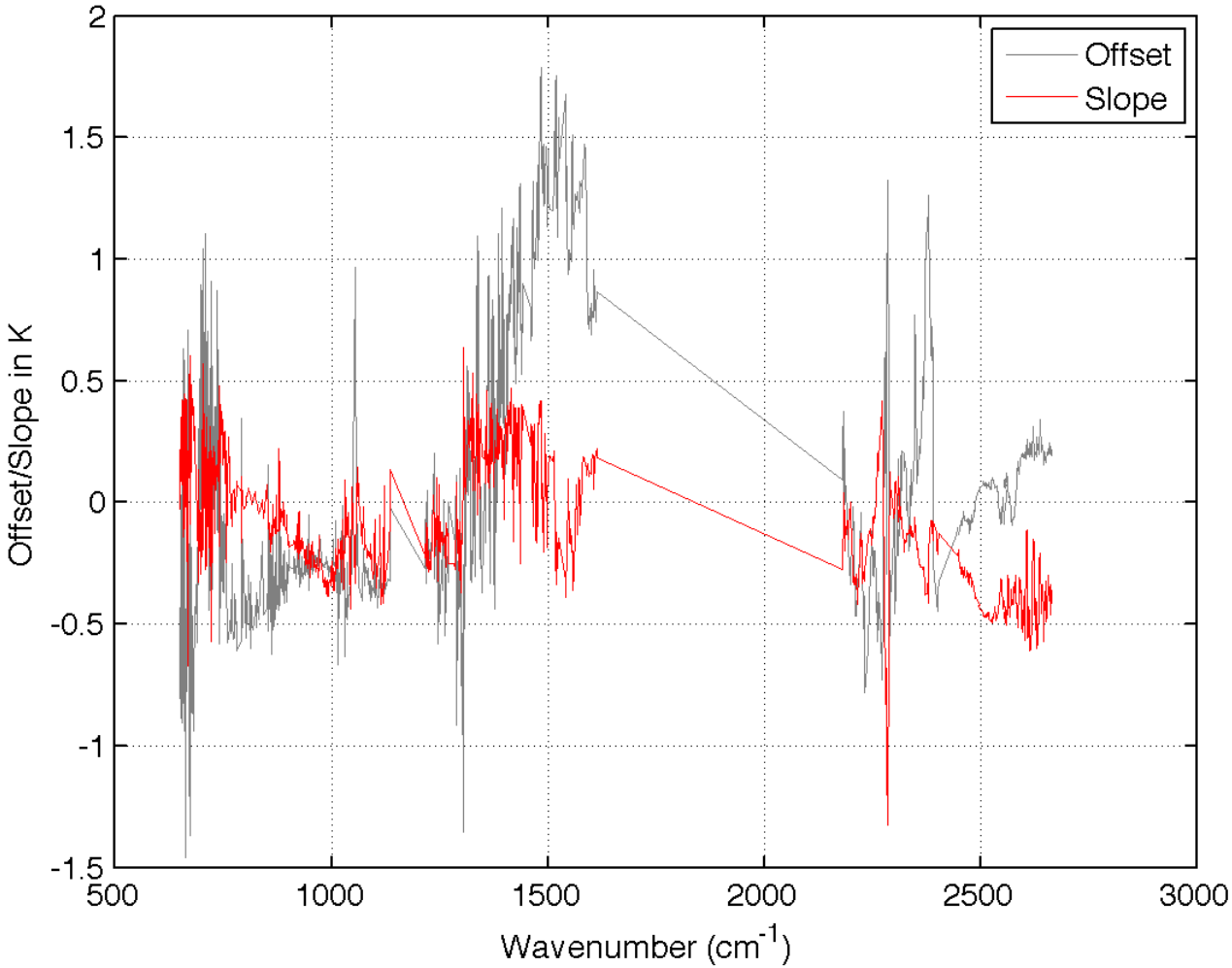
AIRS Slope and Offset

Offset is due to model (and maybe AIRS a little). Generally larger than slope.



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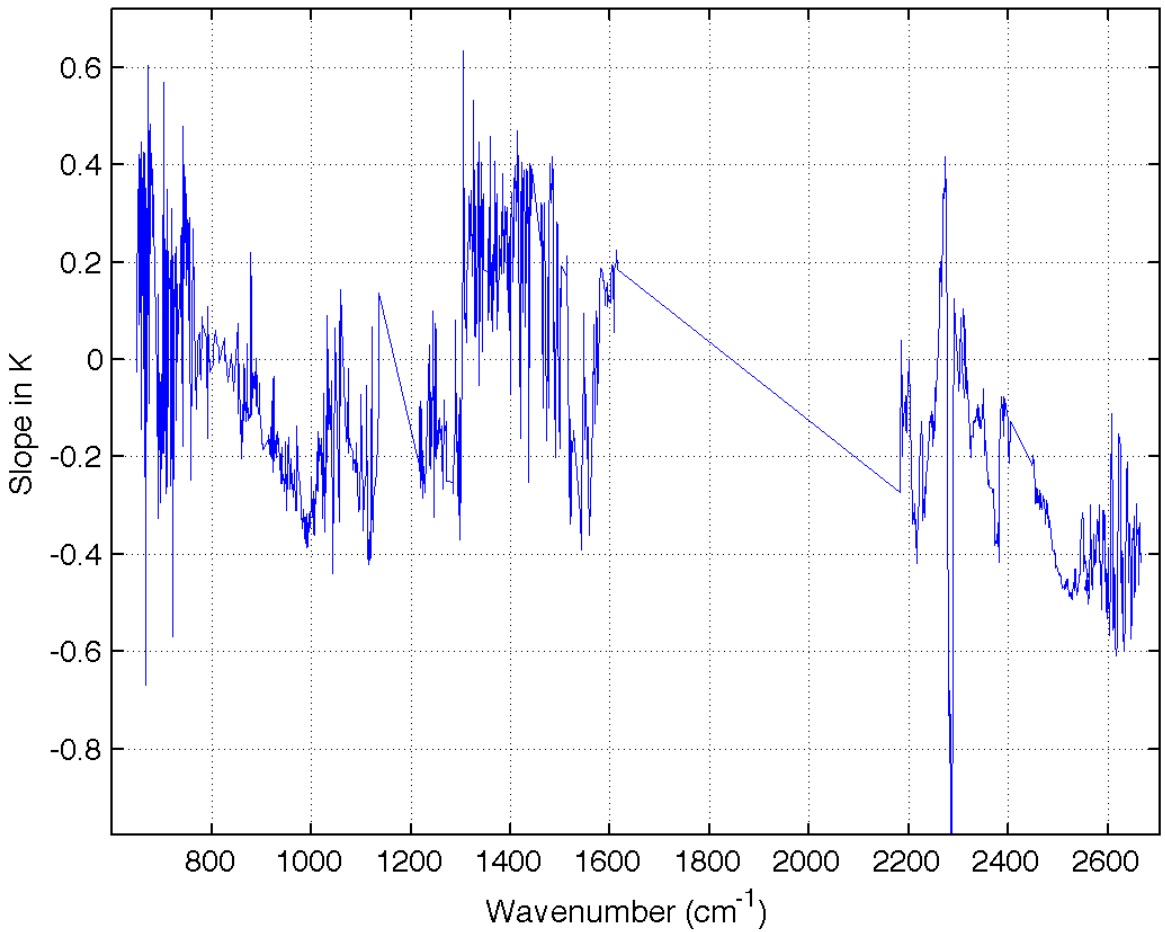
AIRS Slope

Window regions might contain error in not using scene angle dependence of sea surface emissivity. Models available, not yet implemented.



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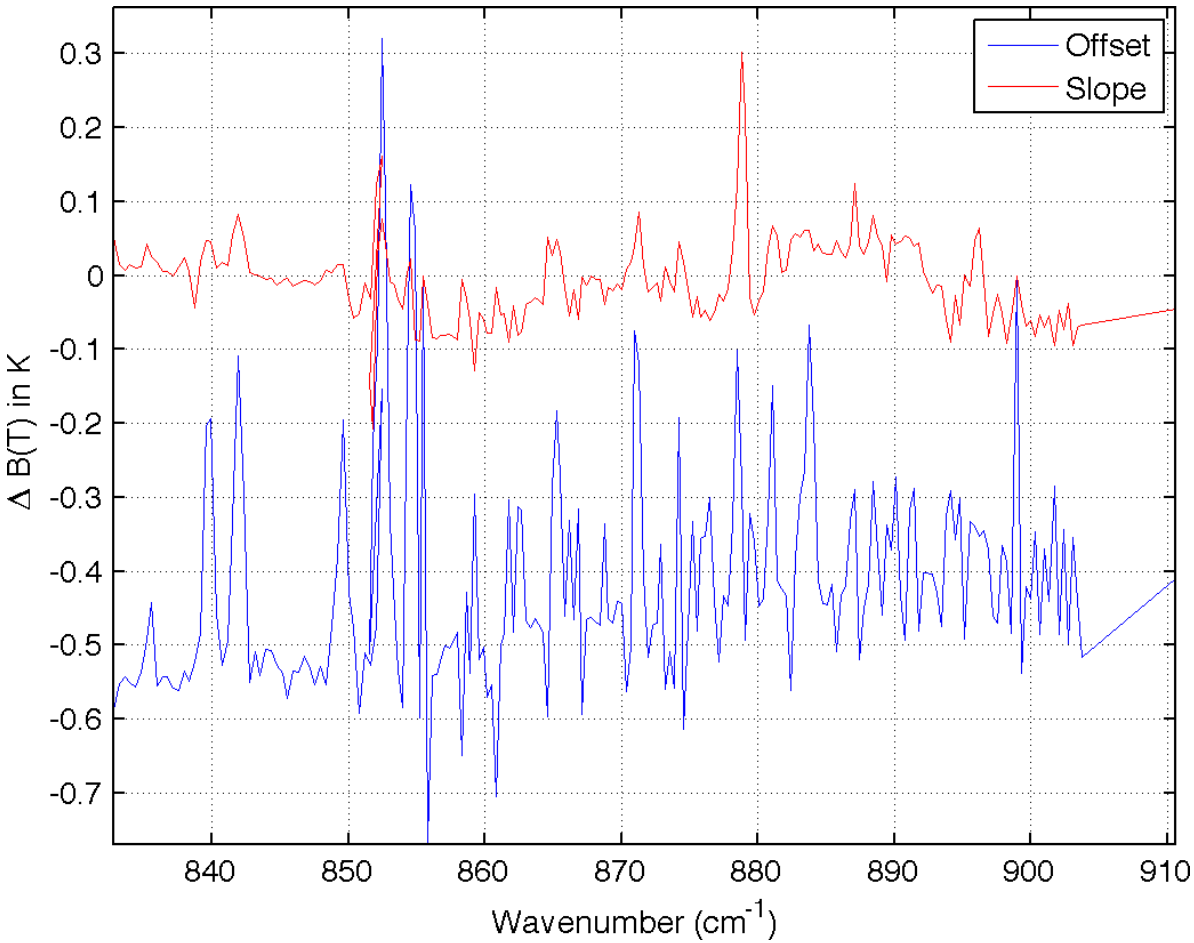
Secant Offset Highlights A/B Detector Calibration

Secant offset, using nominal 300K BT data, shows A/B detector calibration differences. Slope does highlight HNO3 spectroscopy errors at 879 cm^{-1}.



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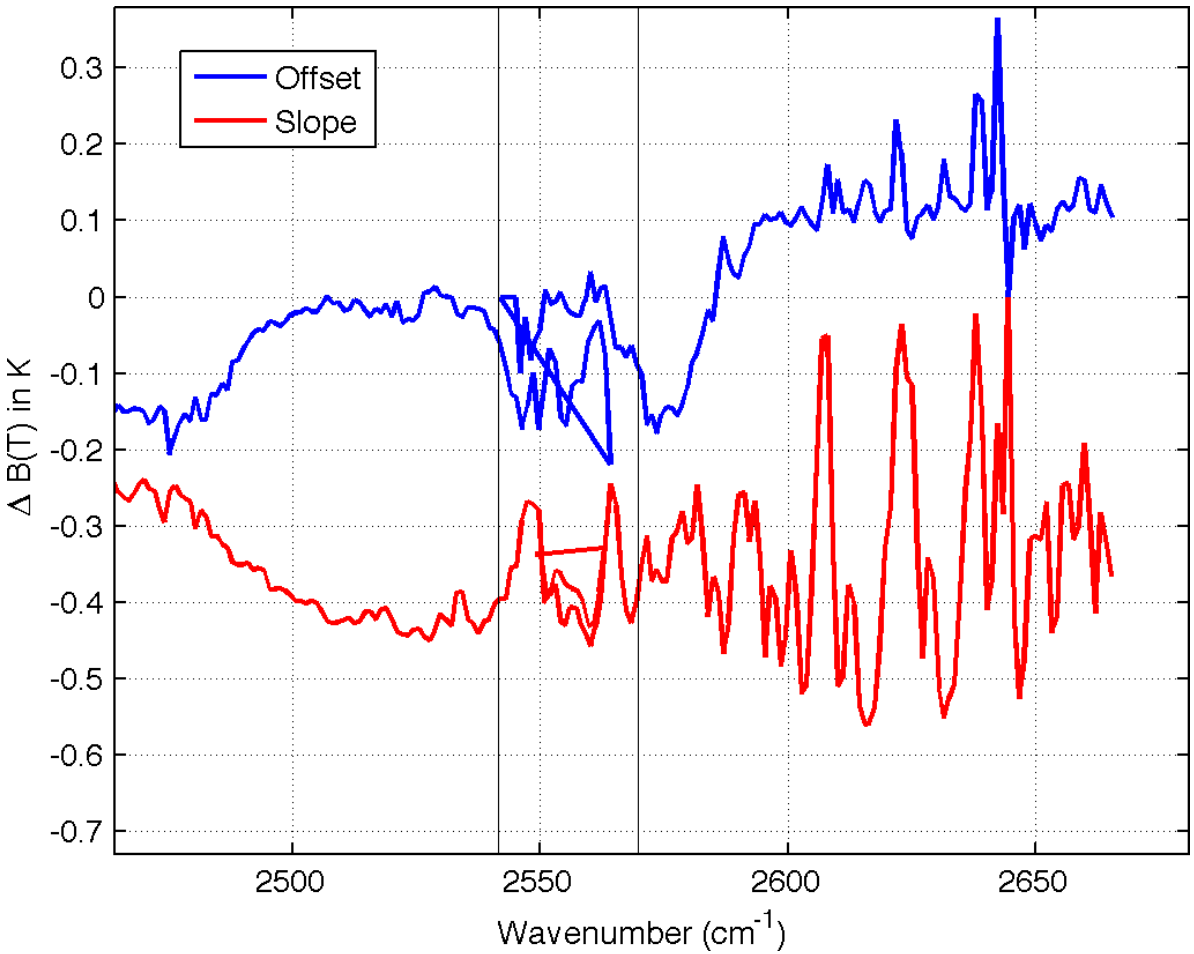
Secant Offset Shows SW Module Offsets

Slope error may be angle dependence of sea surface emissivity.
Note strong water line slopes near zero.



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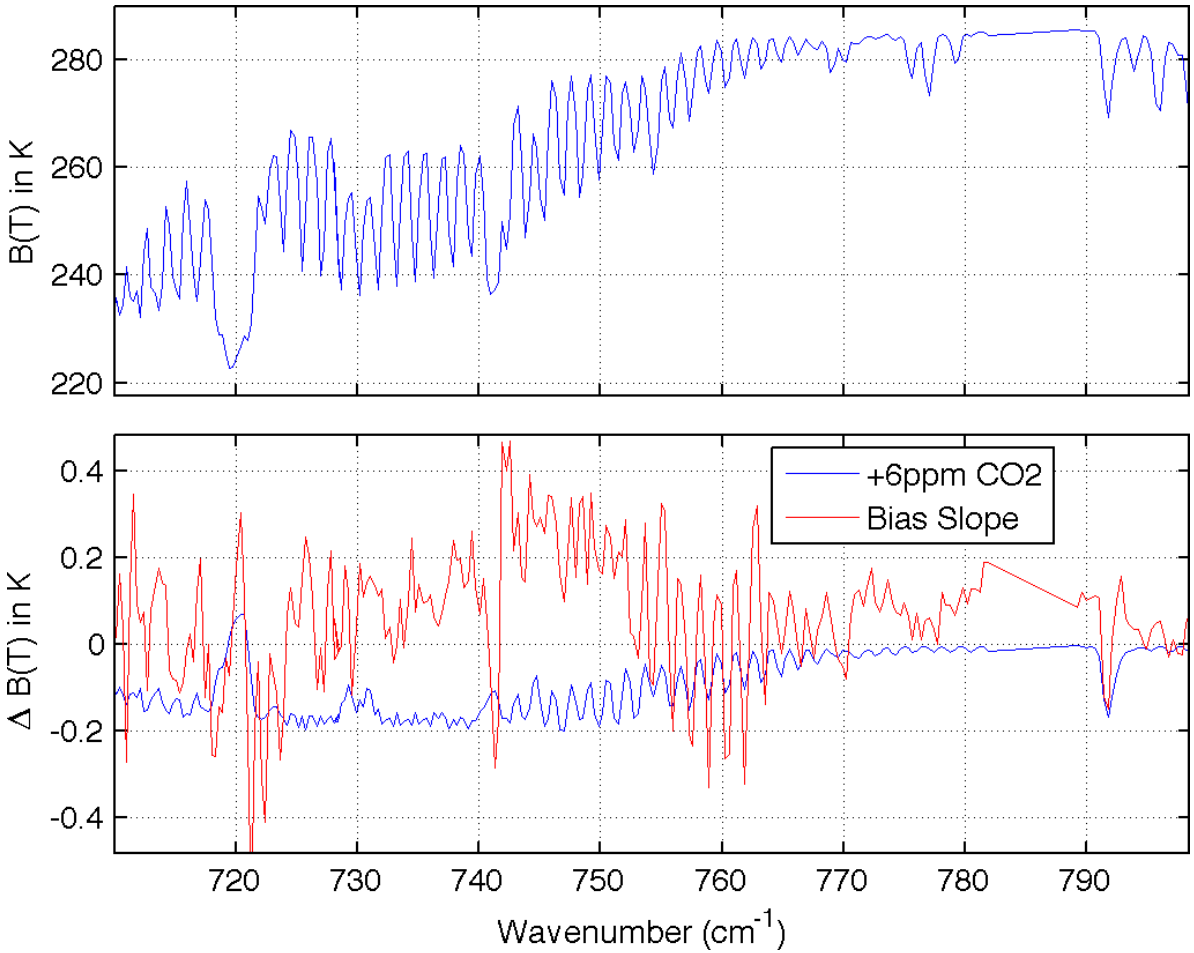
Secant Slope Agrees with Absolute Bias at 791.7 cm^{-1}

Extensive validation of 791.7 cm^{-1} channel, using MLO CO_2 suggests +6 ppm adjustment to RTA. Agrees with bias slope using global data.



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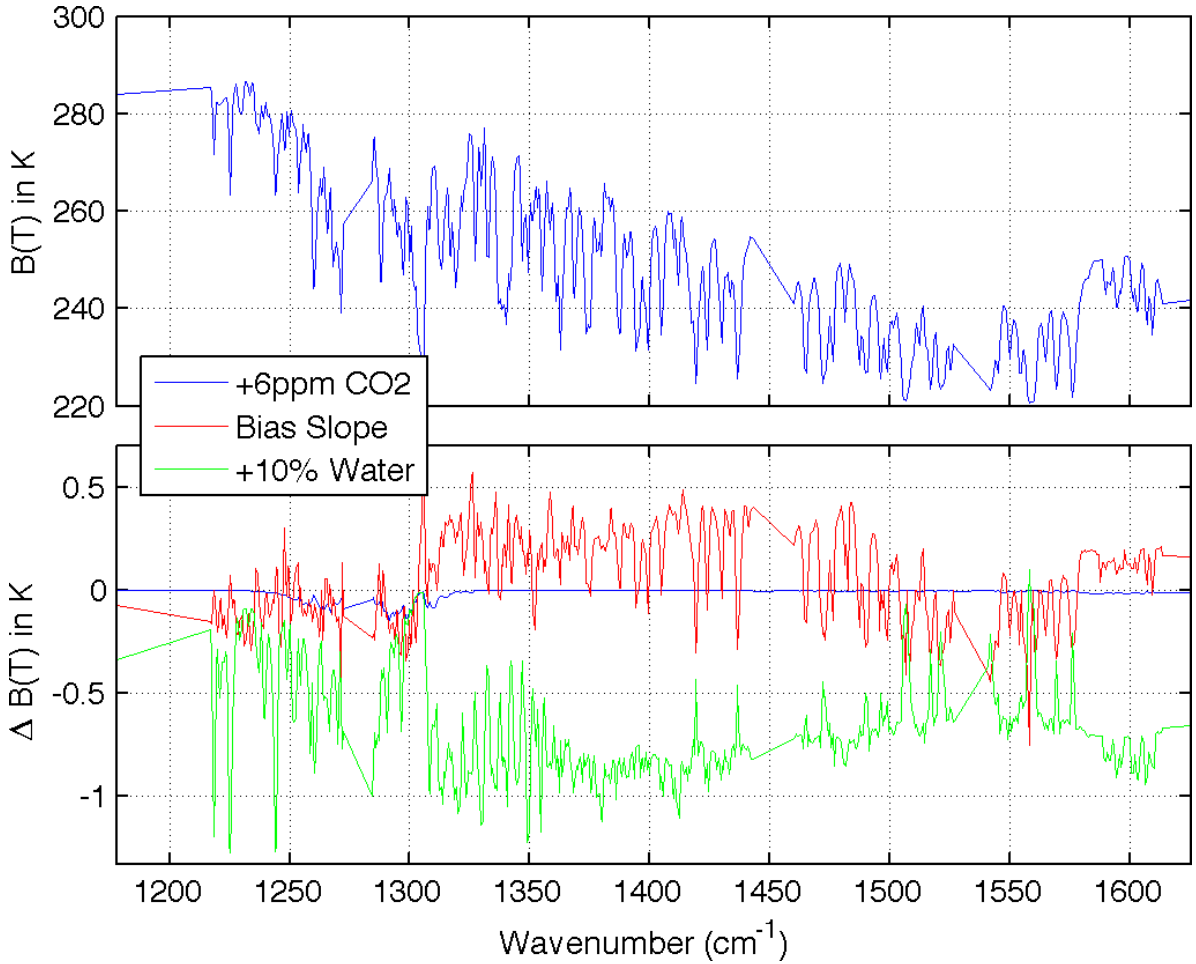
Secan Slope in Water Band

Suggests that RTA water spectroscopy is reasonably good, improvements possible? Note new HITRAN water already implemented, to some degree, in RTA using our empirical tuning soon after launch.



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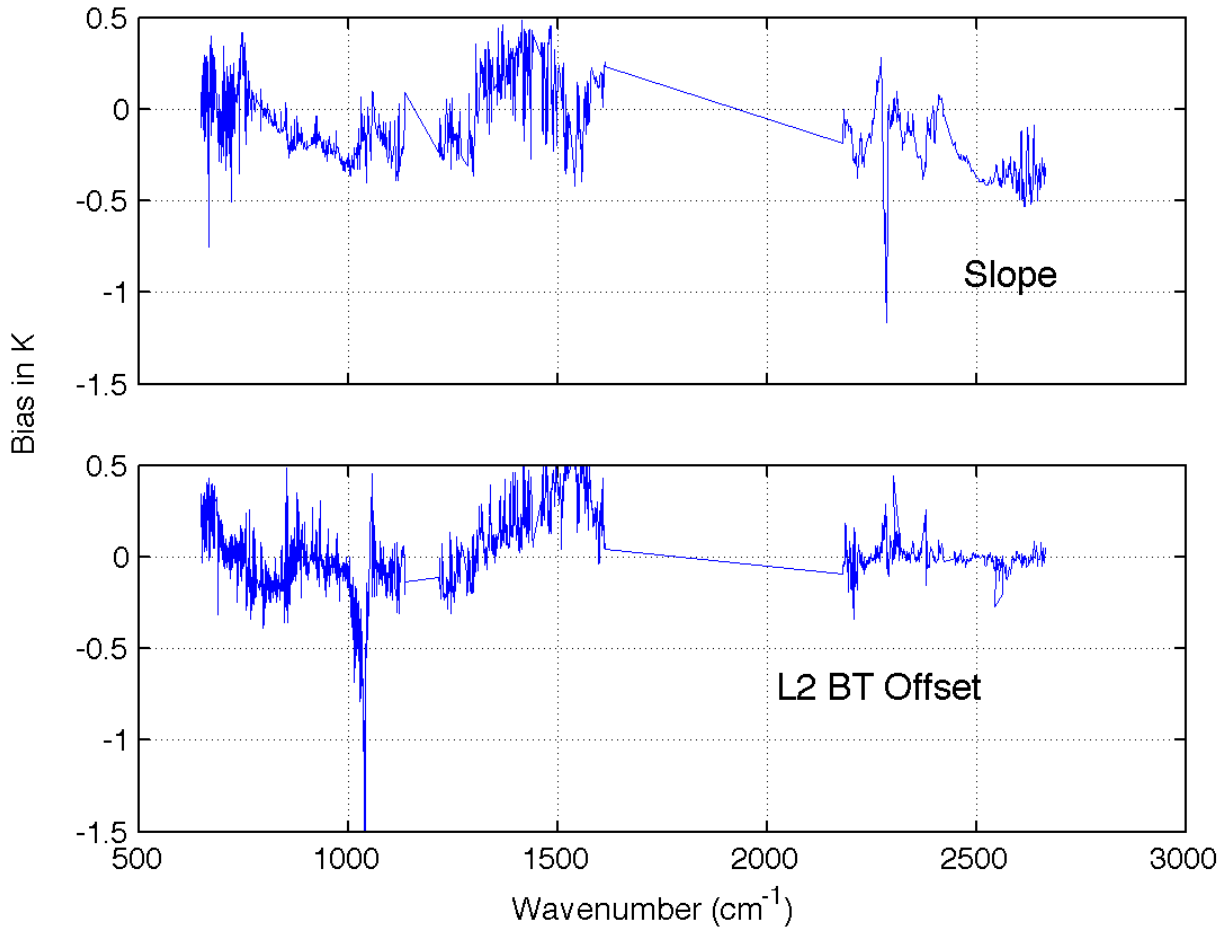
Compare Slope Error to L2 BT Correction

The B(T) slope with secant angle is top panel. Bottom is V5 Level 2 offset "correction" to radiances. (Independent of profile?)



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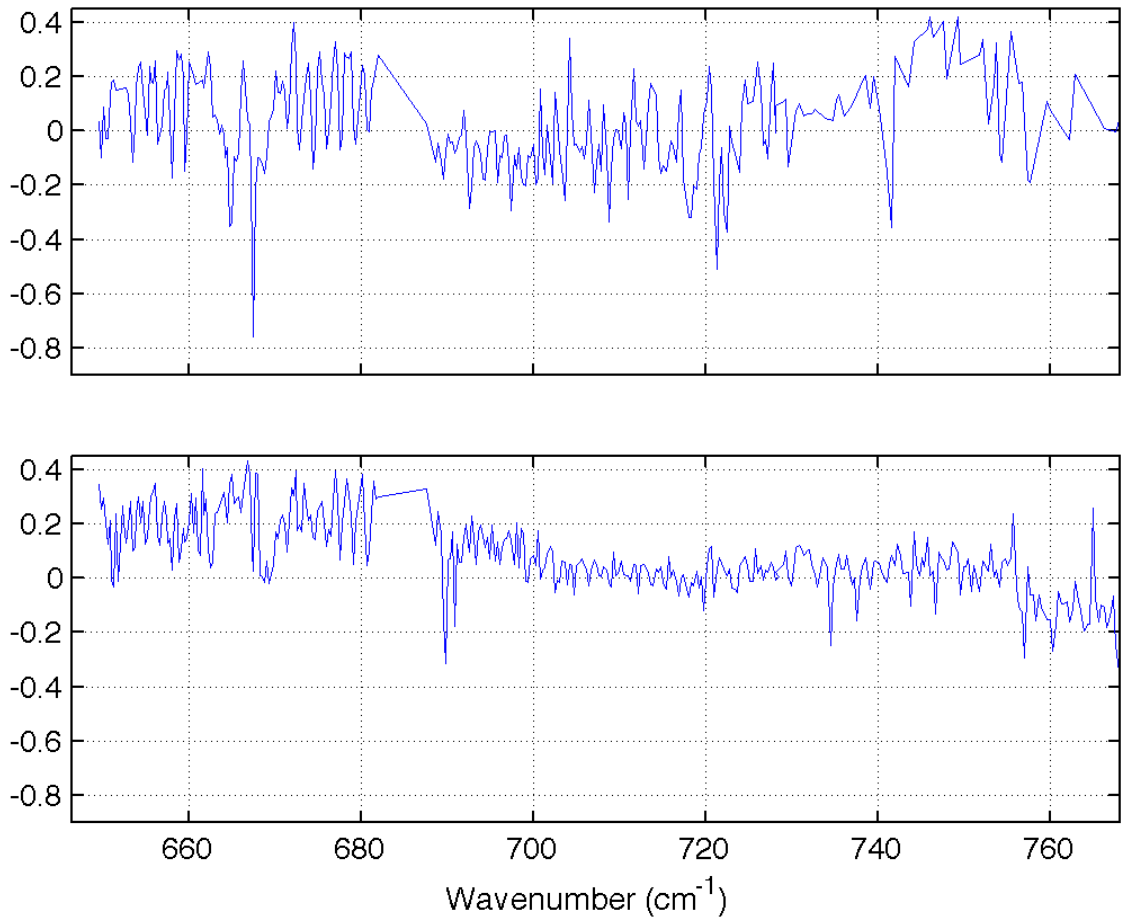
Compare Slope Error to L2 BT Correction: Zoom

Top: Secant angle slope, Bottom: L2 B(T) offset correction



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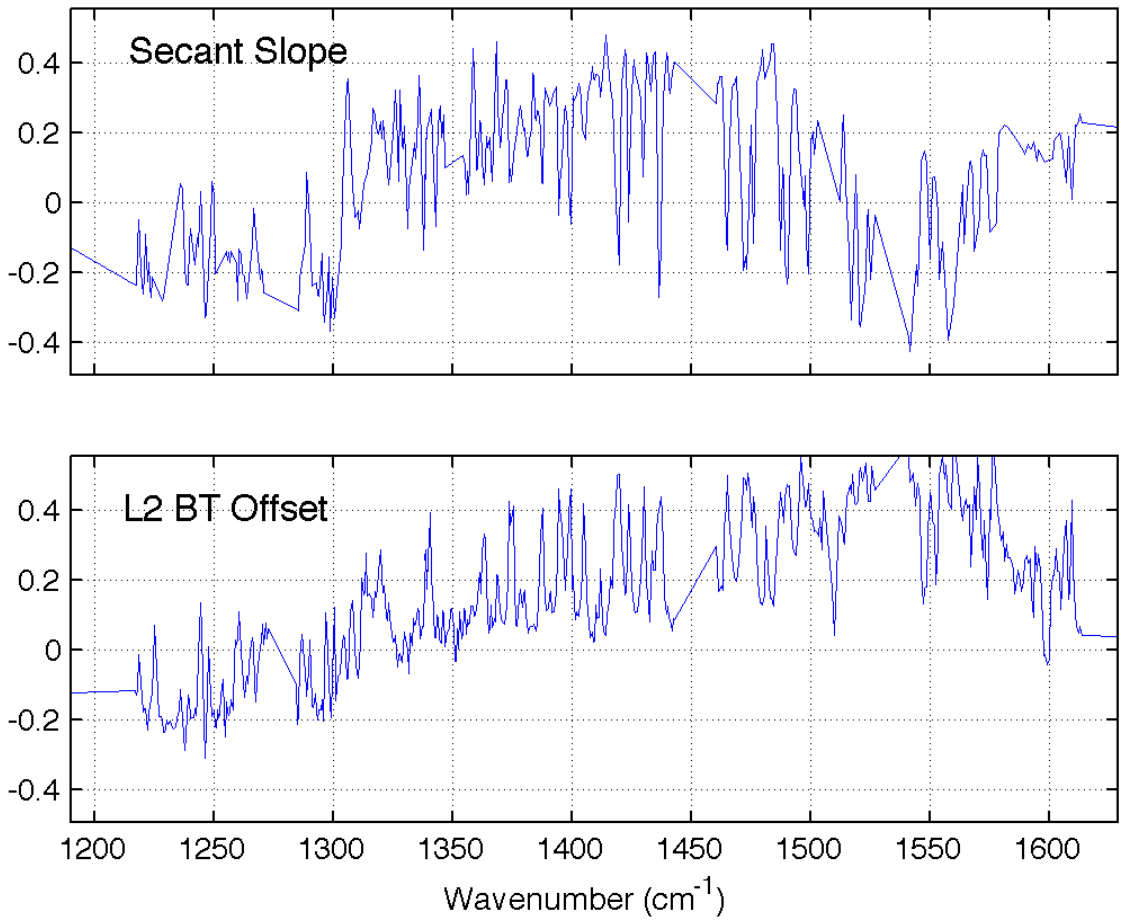

Conclusions

- Following the assimilation community, we should consider corrections to RTA using secant angle bias errors
- I would implement these corrections as adjustments to the gas optical depths, or equivalently to the absorber strength
- This approach is more physical than applying a B(T) offset to all spectra, regardless of the profile
- I do not know how the L2 correction is derived. Which correction is right?
- Consider this approach for V6?